



INTRAVASCULAR DEVICE INFECTIONS

October 18, 2022

Vascular Access Devices

Peripheral Vascular Device: Used for blood sampling, infusion therapy, medication administration and hemodynamic monitoring. Blood Stream Infection (BSI) risk is LOW.

Midline Catheters: Peripherally inserted and are 8-10 cm long. Can remain in place for up to 30 days but cannot accommodate irritant or vesicant infusions.

PICC Lines: Peripheral inserted central catheters can be used for infusion therapy lasting months to years. They are considered CVCs and can accommodate TPN, chemo, vesicant and irritant infusions.

Percutaneous Short Term CVADs: Non-tunneled CVADs are intended for short-term infusion therapy.

Tunneled Long Term CVADs: Intended for long-term infusion therapy. Surgically inserted with a cuff and reduces the risk of bacterial entry into the bloodstream.

Implanted Ports: Surgically inserted and tunneled, but no external catheter visible. Intended for long-term infusion therapy. Port is accessed with a non-coring Huber needle when needed and has the lowest reported rates of BSI.

Table 35-1 Rates of Bloodstream Infection Caused by Various Types of Devices Used for Vascular Access

| Device (Number of Prospective Studies) | Rates of Device-associated BSI | | | |
|--|--------------------------------|-------------------|-------------------------|-------------------------|
| | Per 100 Catheters | Per 100 Catheters | Per 1,000 Catheter Days | Per 1,000 Catheter Days |
| | Pooled Mean | 95% CI | Pooled Mean | 95% CI |
| Peripheral venous catheters (10) | 0.1 | 0.1 to 0.2 | 0.5 | 0.2 to 0.7 |
| Arterial catheters (14) | 0.8 | 0.6 to 1.1 | 1.7 | 1.2 to 2.3 |
| Short-term, non-medicated CVCs (79) | 4.4 | 4.1 to 4.6 | 2.7 | 2.6 to 2.9 |
| Pulmonary artery catheters (13) | 1.5 | 0.9 to 2.0 | 3.7 | 2.6 to 5.0 |
| Hemodialysis catheters: Non-cuffed (16) | 8.0 | 7.0 to 9.0 | 4.8 | 4.2 to 5.3 |
| Hemodialysis catheters: Cuffed (16) | 21.2 | 19.7 to 22.8 | 1.6 | 1.5 to 1.7 |
| Peripherally inserted central catheters (15) | 3.1 | 2.6 to 3.7 | 1.1 | 0.9 to 1.3 |
| Long-term tunneled and cuffed CVCs (29) | 22.5 | 21.2 to 23.7 | 1.6 | 1.5 to 1.7 |
| Subcutaneous central venous ports (14) | 3.6 | 2.9 to 4.3 | 0.1 | 0.0 to 0.1 |

Question #1

Which of the following veins, when used for catheter insertion, has been associated with a lower incidence of central line-associated bloodstream infection (CLABSI)?

- A. Brachial
- B. Femoral
- C. Internal jugular
- D. Subclavian

Answer #1

Which of the following veins, when used for catheter insertion, has been associated with a lower incidence of central line-associated bloodstream infection (CLABSI)?

- A. Brachial
- B. Femoral
- C. Internal jugular
- **D. Subclavian**

Rationale:

The subclavian area is the least likely area to get contaminated, and the most stable area to keep a dressing in place. Avoid femoral sites due to high contamination risk of stool and yeast.

Question #2

The CDC recommendations for decreasing CLABSI include all of the following *except*:

- A. Educational Programs
- B. Routine replacement of catheters
- C. The use of chlorhexidine for skin antisepsis
- D. The use of maximal sterile barrier precautions

Answer #2

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- **B. Routine replacement of catheters**
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- D. The use of maximal sterile barrier precautions

Rationale:

Studies have shown that there is no benefit to routine replacement of short-term CVCs and there should not be scheduled replacements with lines that are functioning well and show no clinical signs of infection.

Question #3

Which of the following statements is true regarding CVCs?

- A. Anticoagulant therapy can reduce the risk of catheter-related infection
- B. Positioning at the insertion site minimizes catheter tip malposition
- C. The CVC should be sutured in place
- D. Stopcocks can increase the contamination risk

Answer #3

Which of the following statements is *true* regarding CVCs?

- A. Anticoagulant therapy can reduce the risk of catheter-related infection
- B. Positioning at the insertion site minimizes catheter tip malposition
- C. The CVC should be sutured in place
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Rationale:

CVCs with the minimum number of ports should be used. Stopcocks represent a potential portal of entry for microorganisms into vascular access catheters. A closed system is associated with fewer catheter-related infections.
(Other securement devices besides sutures should also be considered)

Question #4

Which interventions lead to a reduction of catheter-related infection? (select all that apply)

- A. Hand hygiene
- B. Avoiding femoral sites
- C. Use of chlorhexidine at insertion site
- D. Use of maximal sterile barriers on insertion of CVC
- E. Removal of the device as soon as possible

Answer #4

Which interventions lead to a reduction of catheter-related infection? (select all that apply)

- A. Hand hygiene
- B. Avoiding femoral sites
- C. Use of chlorhexidine at insertion site
- D. Use of maximal sterile barriers on insertion of CVC
- E. Removal of the device as soon as possible

Rationale:

All of the above have proven to reduce catheter-related infections and are best practice.

Question #5

True or False:

The use of CVC dressings that include a chlorhexidine-impregnated disk or sponge have proven to reduce catheter associated blood stream infections.

Answer #5

True or False:

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Rationale:

Chlorhexidine disks that maintain a high concentration of the antiseptic on the insertion site under the dressing, are good for cutaneous disinfection and reduce infection.

Question #6

Mr. Z was admitted to the hospital with endocarditis and will need 6 weeks of antibiotics.

Which intervention is the most appropriate at discharge?

- A. Schedule a replacement of his CVC every 2 weeks with Interventional Radiology until his abx course is complete
- B. Place a single lumen CVC for abx use
- C. Instruct Mr. Z that it is ok to submerge his CVC in the bath, as long as he changes the dressing before bedtime.
- D. Mr. Z shouldn't be discharged and should stay in the hospital for the 6- week duration.

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Rationale:

Multilumen CVCs are associated with a higher risk of infection than are single lumen catheters.

Urinary Tract Infections

Review Questions

Question #1

What is the most common underlying cause of acute pyelonephritis in children

- A. Diabetes Mellitus
- B. Urinary obstruction
- C. Immunosuppression
- D. Urinary catheters or stents

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All of these factors can contribute to acute pyelonephritis, but obstruction disease is the most common cause in children. Obstructive disease is often related to congenital malformation but can be related to other causes such as stones or scar tissue.

Question #2

True or False: The majority of urinary tract infections are caused by Gram-negative bacteria

- A. True
- B. False

Answer #2

True or False: The majority of urinary tract infections are caused by Gram-negative bacteria

- A. True
- B. False

Table 34-1 Bacterial Etiology of Urinary Tract Infections

| Bacteria | % Uncomplicated | % Complicated |
|----------------------------------|-----------------|---------------|
| Gram negative | | |
| <i>Escherichia coli</i> | 70–95 | 21–54 |
| <i>Proteus mirabilis</i> | 1–2 | 1–10 |
| <i>Klebsiella</i> species | 1–2 | 2–17 |
| <i>Citrobacter</i> species | < 1 | 5 |
| <i>Enterobacter</i> species | < 1 | 2–10 |
| <i>Pseudomonas aeruginosa</i> | < 1 | 2–19 |
| Other | < 1 | 6–20 |
| Gram positive | | |
| Coagulase-negative staphylococci | 5–10* | 1–4 |
| Enterococci | 1–2 | 1–23 |
| Group B streptococci | < 1 | 1–4 |
| <i>Staphylococcus aureus</i> | < 1 | 1–23 |
| Other | < 1 | 2 |

Question #3

Which is not a step in obtaining a “clean catch” urine sample

- A. Swabbing the urethra and surrounding area with betadine
- B. Using a sterile collection container
- C. Obtaining a midstream sample
- D. Instructing the patient to touch only the outside of the collection container

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Betadine is often used prior to catheter insertion, but a mild cleanser is sufficient for obtaining a clean catch urine specimen. Chlorhexidine is occasionally used, but the staining properties of betadine make it an impractical choice.

Question #4

You are evaluating a urine culture that indicates heavy growth of *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*. Which is the most appropriate

- A. Antimicrobial therapy to cover all three organisms
- B. Antimicrobial therapy to cover the organism with the highest colony count
- C. Obtain a new specimen for culture
- D. Clinical evaluation of the patient

Answer #4

You are evaluating a urine culture that indicates heavy growth of *Escherichia coli*, *Staphylococcus aureus*, and *Candida albicans*. Which is the most appropriate next step for this patient.

- A. Antimicrobial therapy to cover all three organisms
- B. Antimicrobial therapy to cover the organism with the highest colony count
- C. Obtain a new specimen for culture
- D. Clinical evaluation of the patient**

Cultures that identify three or more organisms should be considered contaminated and cannot be used to guide antimicrobial therapy. It may be necessary to send a repeat culture, but first the patient should be assessed to determine whether a culture is still warranted.

Question #5

Leta is an 87 year old nursing home resident who is exhibiting increased confusion. Her CNA also reports increased urinary odor so a UA and culture was sent. The UA shows +2 WBCs with no other abnormality. Urine culture yields 80,000 count *Klebsiella pneumoniae* that is susceptible to most antibiotics.

- A. Broad spectrum antibiotics
- B. Narrow spectrum antibiotics
- C. Encourage fluids
- D. Blood cultures and evaluation for sepsis

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- B. Narrow spectrum antibiotics
- C. Encourage fluids**
- D. Blood cultures and evaluation for sepsis

Rationale:

Generally, colonization counts of 100,000 or less do not indicate an infection. Dehydration can cause urine to have a strong odor and is a common cause of delirium so encouraging fluids is an appropriate response. Delirium is also often caused by sleep deprivation, pain, medications, or immobility. Infection should only be suspected in the presence of fever, dysuria, or other specific signs or symptoms.

Question #6

The risk of healthcare-associated urinary tract infections in spinal cord injury patients is BEST reduced by:

- A. Prophylactic antibiotics
- B. Bladder instillation of antiseptic
- C. Intermittent catheterization
- D. Placement of all patients with urinary catheters in the same area

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Rationale:

Spinal cord injury can inhibit the patient's ability to empty the bladder on their own. If urine is unable to drain, it may start to grow bacteria. Intermittent catheterization prevents this from occurring.

Question #7

A long-term care facility has 180 residents, 50 of whom have indwelling urinary catheters. An infection preventionist (IP) notes 15 catheterized residents have developed urinary tract infections (UTIs) during one month. Which of the following is the catheter-associated UTI attack rate:

- A. 3.0%
- B. 8.3%
- C. 28.0%
- D. 30.0%

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Rationale:

The CAUTI attack rate is calculated by dividing the number of infections by the total number of catheterized residents ($15/50 = 0.30$)

Indwelling Device Infections

Review Questions

Question #1

The majority of device-associated infections are related to

- A. Gram-positive bacteria
- B. Gram-negative bacteria
- C. Fungus
- D. Prions

Answer #1

The majority of device-associated infections are related to

- A. **Gram-positive bacteria**
- B. Gram-negative bacteria
- C. Fungus
- D. Prions

The majority of device-associated infections are due to Gram-positive bacteria, especially *Staphylococcus aureus* and *Staphylococcus epidermidis*, both of which are able to adhere to devices and biofilms.

Question #2

Which of the following is not true of biofilms?

- A. Biofilms are associated with increased antimicrobial resistance
- B. Biofilms are connected by a matrix of extracellular polysaccharides
- C. Biofilms are generally composed of a single microorganism
- D. Biofilms allow for gene sharing and modification to enhance survival

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Biofilms are often a symbiotic and diverse mix of bacteria and fungi. They are generally between 10-500 times more resistant to antibiotics.

Question #3

Which of the following is not a risk factor for infection of an implantable device?

- A. Corticosteroid use
- B. Poor nutritional status
- C. Anticoagulant use
- D. Severe eczema or psoriasis

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Anything that causes poor or delayed wound healing will increase risk for a device-associated infection including: Systemic corticosteroids, diabetes, poor nutritional status, irritative skin conditions (severe eczema or psoriasis, and obesity

Question #4

A patient underwent a total Rt knee arthroplasty 6 months ago and experienced an uncomplicated recovery. However, he has recently begun complaining of persistent pain in that joint and was diagnosed with a prosthetic joint infection (PJI). Which statement accurately classifies this PJI?

- A. This is an early infection
- B. This is a delayed infection
- C. This is a late infection
- D. This is necrotic implant syndrome

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Early infections are those that occur within 3 months of replacement

Delayed infections occur between 3-24 months post-operatively

Late infections occur more than 24 months after replacement

Delayed and late infections are often subtle and difficult to diagnose. Sometimes persistent joint pain is the only symptom.